REMARKS

Claims 1-28 are all the claims pending in the present application.

The specification has been amended to incorporate by reference several publications that disclose background information describing examples of methods known in the art for using simulated aerial images to improve lithographic processes. Several of these publications were previously disclosed in an Information Disclosure Statement. A copy of one additional reference is provided in an Information Disclosure Statement, attached hereto. No new matter has been added.

Claims 1, 2, 3, 8, 9, 11, 12, 13, 14, 15, 16, 17, 21, 22, 25, 26, 27 and 28 stand rejected on prior art grounds.

Claims 1-28 stand rejected under 35 U.S.C §112.

Reconsideration of the rejections is respectfully requested based on the following discussion.

I. The 35 U.S.C. §102(e) Rejection based on Socha.

Claims 1, 2, 8, 9, 11, 12, 15, 16, 21, 22, 25 and 26 stand rejected under 35 U.S.C. §102(e) as being anticipated by Socha (US Patent Application Publication no. 2002/0152452).

The Office Action alleges that Socha teaches contour integrals, citing page 4 paragraph [0068] equations 6 and 7. Applicants respectfully traverse this interpretation of Socha.

Although Socha recites "each of Equations 6 and 7 extends <u>across</u> two lines" (emphasis added), that statement does not mean that Equations 6 and 7 are line or contour integrals. As understood, the lines that Socha refers to are merely lines comprising patterns to be images, as illustrated in FIG. 12 and discussed in paragraphs [0094]-[0095]. In particular, the statement that Equations 6 and 7 extend <u>across</u> two lines means that the integrals included in those equations cannot be interpreted to be equivalent to line or contour integrals.

Applicants first note (see "Advanced Engineering Mathematics", by Erwin Kreyszig, 4th Edition, John Wiley & Sons (1979), pp. 408-412, pp. 416-419 and pp. 423-427, a copy of which is included in an Information Disclosure Statement filed herewith, hereinafter "Kreyszig") that a line integral of a function F(x,y,z) <u>along</u> a curve C from a point A to a point B may be denoted by the expression:

$$\int_C F[x(s), y(s), z(s)]ds$$

where the orthogonal x,y,z coordinates are functions along the arc length s along the curve C, where the "curve C is called the path of integration." (Kreyszig, pg. 410, emphasis in the original) If the curve C is a closed path, the following notation is often used:

$$\oint_C Fds.$$

A double integral of a function F(x,y) over a region R, where R is bounded by a curve, is denoted by the symbol

$\iint_R F(x, y)dxdy$. (see Kreyszig, pg. 416-417).

A double integral may be transformed into a line integral, according to the following expression:

$$\iint_R \left(\frac{\partial g}{\partial x} - \frac{\partial f}{\partial y}\right)dxdy = \int_C (fdx + gdy),$$

where f(x,y), g(x,y) are continuous functions in the region R, which has a boundary C, and have continuous partial derivatives, $\frac{\partial g}{\partial x}, \frac{\partial f}{\partial y}$, respectively, in the region R. (see Kreyszig, pp. 423-424). Applicants note that the integration of the line integral on the right hand side of the above equation is taken along the boundary C, while the integration of the double integral on the left hand side of the above equation is taken within the region R.

Thus, in Socha, Equations 6 and 7 include a double integral over variables α and β where α and β vary continuously within the region σ that satisfies the condition $\sqrt{\alpha^2 + \beta^2} < \sigma$. Thus, the double integrals in Equations 6 and 7 are integrals over the region σ, and are not contour (or line) integrals. Nowhere in Socha is there any teaching or suggestion that the TCC may be computed as a sum of contour integrals, nor is there any teaching or suggestion that the TCC integrals may be transformed into contour integrals.

Therefore, Applicants submit that Claims 1, 2, 8, 9, 11, 12, 15, 16, 21, 22, 25 and 26 are patentable over Socha. Thus, Applicants respectfully request that these rejections be reconsidered and withdrawn.

II. The 35 U.S.C. §103(a) Rejection based on Socha in view of Kintner.

Claims 3 and 17 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Socha, in view of Kintner.

As discussed above, Socha fails to teach each and every aspect of Applicant's invention. In particular, Socha fails to disclose integrating said integrand for each of the finite number of arcs (that comprise the boundary of the integration region) to obtain a finite number of contour integrals each corresponding to one of said finite number of arcs, wherein each of said finite number of contour integrals comprises an analytical solution.

As understood, Kintner discloses the properties of a given optical system are described in terms of the transmission cross coefficient, and for aberration-free systems with circular pupils, the cross coefficient can be calculated analytically, and for aberrated or apodized sysems, a 1-D approximation can be used (Abstract). However, Kintner fails to overcome the deficiencies of Socha, and in particular, Kintner fails to teach or suggest integrating said integrand for each of the finite number of arcs (that comprise the boundary of the integration region) to obtain a finite number of contour integrals each corresponding to one of said finite number of arcs, wherein each of said finite number of contour integrals comprises an analytical solution. Therefore, one skilled in the art would not be motivated to combine the teachings or suggestions of Socha and Kintner to arrive at the present invention.

Thus, Applicants submit that claims 3 and 17 are patentable over the cited references, and respectfully request that these rejections be reconsidered and withdrawn.

III. The 35 U.S.C. §103(a) Rejection based on Socha in view of Arnison et al.

Claims 13, 14, 27 and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Socha in view of Arnison et al.

As discussed above, Socha fails to teach each and every aspect of Applicant's invention.

As understood, Arnison et al. disclose calculating a 3D vectorial optical transfer function directly from the vectorial pupil function, without making the paraxial assumption nor assuming radically symmetric pupils (Abstract). However, Arnison et al. fails to overcome the deficiencies of Socha, and in particular, Arnison et al. fails to teach or suggest integrating said integrand for each of the finite number of arcs (that comprise the boundary of the integration region) to obtain a finite number of contour integrals each corresponding to one of said finite number of arcs,

wherein each of said finite number of contour integrals comprises an analytical solution. Therefore, one skilled in the art would not be motivated to combine the teachings or suggestions of Socha and Arnison et al. to arrive at the present invention.

Thus, Applicants submit that claims 13, 14, 27 and 28 are patentable over the cited references, and respectfully request that these rejections be reconsidered and withdrawn.

IV. The rejections under 35 U.S.C. §112.

Claims 1-28 stand rejected under 35 U.S.C. §112, first and second paragraphs.

Applicants respectfully traverse these rejections.

There is ample support in the specification of examples of known methods of improving lithographic processes using simulated images, for example, beginning on page 1, line 27 through page 4, line 7. Such methods include, but are not limited to: model-based OPC to improve the design of a lithographic mask, including i) improved design of subresolution assist features (SRAFs) or phase shifted mask (PSM) technology; ii) evaluation and selecting among different resolution enhancement technologies, for example, determining whether the use of SRAFs or PSM would be preferred in a lithographic process; and iii) improving metrology tools and methods which in turn are used to improve lithographic processes. Although Applicants believe that the specification was previously sufficiently enabling support, nonetheless, the specification has been amended to incorporate by reference several previously submitted publications and one additional publication to provide further support for methods known in the art for improving lithographic processes using simulated images. No new matter has been added. Thus, Applicants submit that the specification describes the subject matter of claims 1-28 in sufficient detail to enable one skilled in the art to make and/or use the invention, and that claims 1-28 are neither indefinite nor incomplete.

Applicants respectfully request that these rejections be reconsidered and withdrawn.

V. The Granik et al. reference

The Office Action alleges that Granik et al. (US 6,643,616) discloses using contour integrals in order to improve a lithographic process. Applicants respectfully disagree. As understood, Granik et al. merely discloses the use of a simulated aerial image in model-based OPC. All references to a contour in Granik et al. merely refer to a contour of the image that

represent, for example, constant intensity of the image, but nowhere in Granik et al. is there any teaching or suggestion for determining a transmission cross-coefficient (TCC) comprising a sum of a finite number of contour integrals.

CONCLUSION

In view of the foregoing, Applicants submit that claims 1-28, all the claims currently being examined in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time. Should the Examiner find the application to be other than in condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below to discuss any other changes deemed necessary. The Commissioner is authorized to charge any additional fees due or credit overpayments to Deposit Account No. 09-0458.

Applicants' undersigned attorney may be reached by telephone at (845) 894-6919. All correspondence should continue to be directed to the address listed below.

Respectfully submitted,

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